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This manual reports on a study which was undertaken during the school year 1963-64 to determine the effectiveness of three methods of preparing elementary school teachers to teach the "new mathematics" curricula. The first method involved a series of class sessions centering around material presented in the School Mathematics Study Group text, "A Brief Course in Mathematics for Elementary School Teachers." The second used the text and, in addition, a series of 30 supplementary films shown via projector. The third used the text and the same films shown via television. In this study, it was expected that this education would produce favorable changes in teachers' ability to understand the concepts involved in the "new" mathematics and in their attitudes towards mathematics teaching. In order to measure these changes, an opinion inventory and two parallel forms of a mathematics test were administered to each teacher before starting and after completing the course. The data indicated that the methods may be substituted for each other in the education of teachers. (RP)

No. 3

A Film-Film Text Study

Helen Pollack

Financial support for the School Mathematics Study Group has been provided by the National Science Foundation.

Preface

The data analyzed in this report were collected in the 1963-64 academic year. Statistical analyses of the data were carried out in the following academic year and the report was written early in 1965. However, publication was delayed in the hope that a further study could throw some light on some of the questions raised in this report.

During the 1965-66 academic year an attempt was made to carry out a study comparing two in-service programs, one based on organized class discussions, the other on individual study together with easy access to the films.

No usable information was gained from this study because a substantial number of the participating teachers found it necessary to drop out of the study because of the inauguration of certain new federally financied programs in their school districts.

Although it is hoped that further studies of the effectiveness of films in the in-service training of teachers can be carried out in the future, it seems best not to delay the publication of this report any further.

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I INTRODUCTION

1. Main Study

During the school year of 1963-64 a study was undertaken to determine the effectiveness of three methods of preparing elementary school teachers to teach the "new math" curricula. The first method involved a series of class sessions centering around material presented in the SMSG text, A Brief Course in Mathematics for Elementary School Teachers. The second used the text and, in addition, a series of 30 supplementary films shown via the usual school projector. The third used the text and the same films shown via television.

It was expected that this training would produce favorable changes in the teacher's ability to understand the concepts involved in the "new" mathematics, and in their attitudes towards mathematics teaching. An opinion inventory and two parallel forms of a mathematics test* were administered to each teacher before starting and after completing the course to measure these changes. Two types of attitude scales were derived from the opinion inventory. One, Traditional - Creative, measures conventional as opposed to the more creative views of mathematics and mathematics teaching embodied in the modern curricula. The other, Like - Dislike, measures the teacher's degree of liking for mathematics and mathematics teaching.

Since, for each method, the way in which classes were conducted varied considerably, questionnaires were sent out to the class instructors to get a picture of the procedures followed in a given class. Data was analyzed from those classes returning a set of mathematics tests and/or opinion inventories, and a questionnaire. Below is a table listing, by method, the number of students and classes included in the analysis.

TABLE I

	Mathematics Tests			Opinion Inventory	
	Classes	Students		Classes	Students
Text	47	872	Text	49	754
Film	20	484	Film	16	184
TV	15	408	TV	14	367
Total	82	1762	Total	79	1305

Class size varied considerably, the range being from 1-43 with a mean of 19.1.

*These tests are reproduced at the end of this report.

2. Virginia Study

In the main study, the same form of the opinion inventory was given before and after the course. However, the pre and post mathematics tests differed. These were designed as parallel tests, and, in order to determine their similarity, both were administered to a group of 127 teachers and prospective teachers in Virginia. In this study the pre test was administered first and the post test a few days later preserving the order of the main study.

3. Kentucky Study

During the summer of 1964, a number of classes in Kentucky used the text and films, via projector, as the basis of an intensive course in teacher education. The classes met for periods of time varying from two to eight weeks. The pre and post mathematics tests were used to provide a comparison with the achievement of teachers in the main study.

II Results

1. Virginia Study

The data from the almost simultaneous administration of the two mathematics tests indicates that they are quite similar, and may safely be substituted for each other to provide a measure of growth. Table II presents basic descriptive statistics for the tests as found in this study.

TABLE II

N = 127	Mean	Standard Deviation
Pre	22.912	8.76
Post	24.079	9.34

Correlation of pre and post = .876

Although the difference between the two means is statistically significant,* this difference is so small that it is not regarded as practically important. In any case, comparisons of the difference between the pre and post tests in the main study use the above difference of 1.167 as a baseline. The difference between the standard deviations is not statistically significant.

*All differences reported as statistically significant refer to the .01 level of probability while those differences reported as not statistically significant had a probability greater than .05.

2. Main and Kentucky Studies

The differences among students using the three methods of instruction on the two attitude scales were negligible, and since these were preliminary versions of what are at present more refined scales, it was decided not to do further analysis of the opinion inventory data.

The table below presents pre, post, and gain score means and standard deviations for the students in each method and in the Kentucky study.

TABLE III

		PRE		POST		GAIN	
	N	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Text	872	19.53	9.21	27.22	10.40	7.68	8.91
Film	482	19.62	7.70	26.96	9.58	7.34	7.46
TV	408	18.29	7.24	27.00	10.36	8.71	8.40
Ky.	476	17.72	7.46	24.73	9.20	7.01	6.10

a. Main Study

Each of the gain score means was tested for significance against the pre-post difference of 1.167 found in the Virginia study and was found to be highly significant. The differences among the gain scores for the three methods was examined. No significant difference was found between students using only the text and those supplementing it with projected films. The differences between those students using only the text and those supplementing the text by TV showings of the films, and between this group and that using projected films, although small, were statistically significant.

A similar type analysis was performed on a sample consisting of those students in organized (as opposed to self-study) classes in which more than 2/3 of the course material had been completed. Table IV presents means and standard deviations for the students in this selected sample.

TABLE IV

		PRE		POST		GAIN	
	N	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Text	533	20.31	8.57	28.19	9.96	7.88	9.17
Film	277	20.56	8.17	27.65	9.44	7.09	7.15
TV	173	19.29	7.34	33.57	7.90	14.28	7.23

Again, the differences between the gain score means and the Virginia study difference are statistically significant; and there is no significant difference between the Text and Film gain scores. However, the differences between the Text and TV, and the Film and TV gain scores are considerable, as well as being highly significant. Implications contained in these results will be taken up below.

b. Kentucky Study

The mean gain score obtained from the Kentucky study was compared with the pre-post Virginia study difference and the gain scores of the three groups in the main study. As in the main study, the gain by the Kentucky students is significantly greater than the Virginia difference. The small differences between the Kentucky, and, Text and Film students of the main study are not statistically significant. The difference between the Kentucky and TV students is highly significant. Thus, it seems that a short intensive course is as effective as a much longer course, at least so far as immediate gains are concerned. No information has been obtained to enable us to compare retention over longer periods of time.

c. Relevant Variables

Information on the sex, age, length of time teaching and grade level presently taught was obtained for the students in the main and Kentucky studies. Mean pre, post and gain scores for each level of these variables were calculated. (See Tables B and C of the Appendix). The differences between levels were often quite small and the variances within each level quite large. In addition, some levels had only a small number of cases. Keeping these cautions in mind, the following trends regarding initial and final scores seemed to emerge:

1. Men score higher than women.
2. Younger people score higher than older people.
3. Teachers of higher grades score higher than lower grade teachers.
4. Teachers with fewer years of teaching experience score higher than those with a great deal of experience.

Two additional pieces of information, number of credits of college mathematics, and highest academic degree obtained, were available for the Kentucky students. Although the cautions mentioned above apply here also, the following trends were noted:

1. The more college mathematics taken, the higher the score.
2. The higher the academic degree achieved, the higher the initial score but the lower the gain score.

It is likely that a number of the above categories are interdependent so that it is difficult to isolate the relevant variables (e.g., There is probably a greater percentage of men teaching higher grades as compared with the lower grades, and so the higher scores of the upper grade teachers may reflect this difference.) Further, it is difficult to speculate on the reasons behind these findings because we have no information on other, potentially relevant variables.

The questionnaire that was sent to the class instructors of the main study was intended to isolate variables present in the classroom situation that seemed likely to influence class achievement. Information about the following variables was obtained:

1. The degree of class organization (i.e., organized class, self-study with aid, self-study without aid).
2. The amount of text and film material covered.
3. The number of hours of, and concentration of, class sessions.
4. The degree to which the teachers participated in the class sessions.
5. The instructor's judgement of the class' motivation to learn the material.
6. The extent to which the class was externally motivated (e.g., by the use of quizzes).
7. The extent to which supplementary materials were used.
8. Class attendance.

As is the case with all self-report instruments, the validity of the questionnaire depends on the accuracy of the memory of the person reporting. In this study a number of months had passed between the end of the course and the time the instructors filled out the questionnaire. In addition many of the questions asked the teachers to make absolute judgements (e.g., they were asked whether the general level of class motivation was high, medium, or low) without providing standards on which to base these judgements.

Class means and standard deviations for pre, post, and gain scores were calculated for each level of these variables (See Table D of the Appendix). The cautions mentioned in connection with the background variables are also applicable in evaluating the following observations:

1. The greater the class organization, the higher the gain score.
2. The more material completed, the higher the gain score.
3. More learning occurs in a lecture-discussion type course than a pure discussion course. However, more learning occurs in a pure-discussion than in a pure-lecture course.
4. The greater the class motivation, as judged by the instructors, the higher the gain score.
5. The more the number of externally motivating factors, the higher the gain score.
6. The better the class attendance, the higher the gain score.

As mentioned above, the classes in the Kentucky study took from two to eight weeks to complete the course. Mean class pre, post, and gain scores were calculated for each of these time periods. As can be seen in Table E of the Appendix, no systematic trend relating achievement to course duration seems evident. Again, the small number of classes, and, large variation within and between classes makes it difficult to draw conclusions. However, since all classes spent approximately the same number of hours on the course, regardless of the number of weeks taken, the above finding may not be too surprising. Here, too, tests of retention may show differences that were not found immediately after course completion.

An attempt was made to track down the great difference in gain scores among the students using TV and the other two methods in the sample selected for class organization and course completion. One rather obvious factor is that there seems to have been more opportunity for repeated viewings of the TV programs than of the projected films. To explore the possibility of other favorable factors, percentages of the number of students falling into each

level of the background categories, and of the number of classes falling into each level of the class variables were obtained for the three methods. (See Tables F and G of the Appendix). The TV students do not have a greater percentage of favorable background factors as compared with those in the other two methods. On the other hand, this group does show a higher percentage of favorable class variables (i.e., at levels of the variables associated with higher scores). However, it is possible that other factors are at work in this group, and that the presence of a large number of TV classes in these categories is the cause of the high scores associated with them rather than vice versa.

Some of these other factors may be connected with the observation, made by a number of people who have worked with TV as an educational medium, that students seem much more attentive to material presented by TV as compared with more conventional methods of teaching. This attentiveness may partly be a result of the newness of television as an educational device, and, of the feeling of personal contact with the TV instructor that student audiences have reported. Further, educational television has often been employed as a medium for primary communication of ideas and information as contrasted with the frequent use of films as entertaining supplements. Thus, TV may have an "image" that is more conducive to serious study than projected films. Whatever the factors responsible for the sharp increase in gain scores, they quite reasonably seem to increase in potency as the degree of material completed increases.

In summary, it must be stated that the many uncontrolled factors present in this study, make it somewhat dangerous to place a great deal of confidence in the above findings. Although, many of the findings seem quite reasonable, the lack of information about how the classes were conducted, how subjects were assigned to classes, the ability and prior experience of the subjects and the competency of the instructors, calls for extreme caution in generalizing from these results. The only clear-cut statement that can be made is that most of the students profited from the training that they received.

TABLE A

MAIN STUDY

MATHEMATICS TESTS SCORES

(calculated from class means)

		PRE		POST		GAIN	
Method	N	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Text	47	20.26	5.17	27.07	5.52	6.81	4.86
Film	20	20.12	2.64	27.22	4.09	7.10	3.25
TV	15	18.69	2.78	27.91	6.37	9.22	5.17

MATHEMATICS TESTS SCORES - Selected Sample

(calculated from class means)

		PRE		POST		GAIN	
Method	N	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Text	23	20.16	4.71	28.22	4.69	8.05	4.91
Film	13	21.07	2.34	27.79	2.98	6.72	2.97
TV	8	19.57	2.57	32.66	3.10	13.10	3.71

TABLE B

MAIN STUDY

MEAN MATHEMATICS TESTS SCORES

BACKGROUND VARIABLES	N	PRE	POST	GAIN
SEX				
Male	246	22.37	30.12	7.75
Female	985	19.11	27.54	8.44
No Response	2	9.00	21.00	12.00
AGE				
20-30 years	301	21.42	28.15	6.73
30-40	272	20.19	29.06	8.87
40-50	273	19.74	28.86	9.11
50-60	291	18.10	26.84	8.74
60-70	90	18.27	26.20	7.93
Over 70	4	14.00	25.75	11.75
No Response	2	22.00	28.00	6.00
NUMPER OF YEARS TEACHING				
0	25	26.08	31.04	4.96
1-3	241	21.17	28.70	7.53
4-10	328	20.11	28.95	8.84
11 and higher	599	18.78	27.38	8.60
No Response	40	18.58	24.90	6.33
GRADE LEVEL TAUGHT				
K and less	9	16.33	24.78	8.44
1 - 3	385	17.36	25.54	8.17
4 - 6	538	19.96	28.17	8.21
7 - 8	105	24.23	32.81	8.58
9 and greater	100	22.00	30.76	8.76
Other School Personnel	72	20.99	30.57	9.58
Pre-Service	13	29.15	29.62	.46
Non-School	3	12.00	22.33	10.33
No Response	7	13.00	24.00	11.00

TABLE C

KENTUCKY STUDY

MEAN MATHEMATICS TEST SCORES

BACKGROUND VARIABLE	N	PRE	POST	GAIN
GRADES PRESENTLY TAUGHT				
K-3	121	15.03	21.55	6.52
4-6	137	16.98	24.78	7.80
7-9	99	21.04	27.64	6.61
10-12	13	25.00	29.31	4.31
Other School Personnel	6	20.17	30.50	10.33
Pre-Service				
Non-School				
No Response	96	17.69	24.79	7.10
NUMBER OF YEARS TEACHING				
1-3	83	19.51	27.41	7.90
4-6	47	19.30	26.57	7.28
7-9	44	17.46	24.96	8.50
10-12	31	17.32	25.48	8.16
13+	199	16.48	22.89	6.42
No Response	57	17.70	23.16	5.46
HIGHEST ACADEMIC DEGREE				
0	92	17.44	24.94	7.50
BA	242	17.63	24.95	7.32
MA	84	19.33	25.92	6.58
Ed D	2	18.50	23.50	5.00
Ph D				
No Response	55	16.04	21.76	5.73

VARIABLE	N	PRE	POST	GAIN
CREDITS IN COLLEGE MATH				
0	204	17.54	24.74	7.20
1-3	81	17.10	24.41	7.31
4-6	63	17.21	23.92	6.11
7-9	33	18.76	26.27	7.52
10+	26	24.58	32.04	7.46
No Response	69	16.38	22.35	5.97
SEX				
Male	73	20.25	27.70	7.45
Female	362	17.24	24.31	7.07
No Response	41	17.51	23.20	5.68
AGE				
20-25	80	20.45	27.75	7.30
26-30	51	20.08	28.37	8.29
31-35	41	17.66	25.49	7.83
36-40	47	17.79	25.79	8.00
41+	206	16.27	22.82	6.55
No Response	51	16.94	22.51	5.57

TABLE D

MAIN STUDY

MEAN MATHEMATICS TEST SCORES
(calculated from class means)

CLASS VARIABLES	CLASS N	PRE	POST	GAIN
MODE OF INSTRUCTION				
Text	47	20.26	27.07	6.8
Film	20	20.12	27.22	7.10
TV	15	18.69	27.91	9.22
CLASS STRUCTURE				
Self-Study	11	20.96	24.71	3.76
Self-Study Aids	8	19.99	25.39	5.60
Org. Class	63	19.76	27.92	8.17
DEGREE OF TEXT COMPLETION				
$0 - \frac{1}{3}$	1	25.92	31.48	5.56
$> \frac{1}{3} - \frac{2}{3}$	15	17.47	24.38	6.86
$> \frac{2}{3}$ - Total	64	20.41	27.89	7.48
No Response	2	20.31	27.06	6.75
DEGREE OF FILM COMPLETION				
$0 - \frac{1}{3}$	--	----	----	----
$> \frac{1}{3} - \frac{2}{3}$	--	----	----	----
$> \frac{2}{3}$ - Total	32	19.39	27.26	7.87
No Response	50	20.29	27.27	6.98
JUDGED MOTIVATION				
Low	8	18.92	22.38	3.46
Medium	49	20.54	27.38	6.82
High	23	18.98	28.78	9.80
No Response	2	20.31	27.06	6.75

CLASS VARIABLES	CLASS N	PRE	POST	GAIN
HOURS SPENT IN CLASS				
$0 < H \leq 10$	18	19.81	25.72	5.90
$11 \leq H \leq 20$	14	18.92	26.81	7.89
$21 \leq H \leq 30$	12	19.28	27.70	8.42
$31 \leq H \leq 40$	9	20.97	32.22	11.25
$41 \leq H \leq 50$	3	19.74	25.92	6.18
$50 > H$	2	17.93	30.96	13.03
No Response	24	20.76	26.47	5.71
CONCENTRATION OF CLASS MEETINGS				
1	27	21.01	28.70	7.69
2	24	18.92	26.82	7.90
3	3	17.62	31.76	14.13
4	2	17.57	25.55	7.98
5	6	18.74	27.74	8.99
6	--	----	----	----
7	--	----	----	----
8	--	----	----	----
No Response	20	20.66	25.21	4.55
STUDENT PARTICIPATION				
Lecture	8	21.82	26.90	5.09
Lecture-Discussion	47	19.41	28.25	8.84
Discussion	8	19.70	26.99	7.29
No Response	19	20.55	25.08	4.53

QUESTIONNAIRE VARIABLES	N	PRE	POST	GAIN
EXTERNAL MOTIVATION				
1	2	20.73	32.40	11.66
2	25	20.10	26.48	6.38
3	14	21.45	28.01	6.56
4	15	18.58	28.87	10.29
5	5	17.12	29.02	11.90
6	2	17.93	30.96	13.03
No Response	19	20.55	25.08	4.53
SUPPLEMENTARY MATERIALS				
1	19	18.93	28.33	9.40
2	16	18.79	26.88	8.09
3	13	20.07	26.30	6.23
4	1	18.00	27.42	9.42
No Response	33	21.08	27.21	6.13
ATTENDANCE - CLASS				
Low	2	16.02	22.23	6.21
Medium	18	20.33	27.80	7.47
High	43	19.69	28.24	8.55
No Response	19	20.55	25.08	4.53
ATTENDANCE - FILMS				
Low	--	----	----	----
Medium	8	22.12	28.27	6.15
High	11	19.96	31.65	11.68
No Response	63	19.66	26.37	6.71

TABLE E

KENTUCKY STUDY

MEAN MATHEMATICS TESTS SCORES

(calculated from class means)

NUMBER OF WEEKS COURSE LASTED	N	PRE	POST	GAIN
2	3	16.988	23.721	6.733
3	8	18.678	27.888	9.211
4	1	16.760	24.920	8.160
5	2	20.820	30.794	9.974
6	4	17.145	22.374	5.229
8	1	14.500	16.643	2.143

TABLE F

FREQUENCIES OF BACKGROUND VARIABLES

SELECTED SAMPLE

VARIABLE	TEXT Total N = 455		FILM Total N = 138		TV Total N = 143	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
SEX						
Male	49	11	66	47	34	24
Female	406	89	72	52	109	76
AGE						
20-30 Years	90	20	39	28	27	19
30-40	82	18	35	25	43	30
40-50	107	24	25	18	44	31
50-60	134	29	28	20	26	18
60-70	41	9	10	7	3	2
Over 70	1	0	1	1		
No Response					1	1
NUMBER OF YEARS TEACHING						
0	6	1				
1-3	73	16	38	28	29	20
4-10	113	25	39	28	57	40
11 and higher	247	54	58	42	58	41
No Response	16	4	3	2		
GRADE LEVEL TAUGHT						
K and less			1	1	2	1
1-3	134	29	28	20	50	35
4-6	172	38	75	54	70	49
7-8	61	13	10	7	12	8
9 and greater	53	12	14	10	5	3
Other School Personnel	28	6	10	7	4	3
Pre-Service	2	0				
Non-School	1	0				
No Response	4	1				

TABLE G

FREQUENCIES OF CLASS VARIABLES

SELECTED SAMPLE

	TEXT Total N = 23		FILM Total N = 13		TV Total N = 8	
VARIABLE	Frequency	Percent	Frequency	Percent	Frequency	Percent
JUDGED MOTIVATION						
Low			1	8		
Medium	13	56	12	92	3	37
High	10	43			5	63
HOURS SPENT IN CLASS						
$0 < H \leq 10$	7	30	4	31		
$11 \leq H \leq 20$	6	26	2	15		
$21 \leq H \leq 30$	1	4	5	38	4	50
$31 \leq H \leq 40$	6	26			1	12
$41 \leq H \leq 50$	2	9				
$50 > H$	1	4				
No Response			2	15	3	38
CONCENTRATION OF CLASS MEETINGS						
1	10	43	9	69	3	38
2	9	39	3	23	4	50
3					1	12
4						
5	4	17				
No Response			1	8		
STUDENT PARTICIPATION						
Lecture	7	30				
Lecture-Discussion	16	69	5	38	8	100
Discussion			8	62		
EXTERNAL MOTIVATION						
1	1	4				
2	13	56	3	23		
3	3	13	6	46		
4	2	9	4	31	7	88
5	3	13			1	12
6	1	4				
No Response						

VARIABLE	TEXT		FILM		TV	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
SUPPLEMENTARY MATERIAL						
1	4	17	6	46	1	12
2	4	17	3	23	7	88
3	8	35				
4						
No Response	7	30	4	31		
CLASS ATTENDANCE						
Low						
Medium	4	17	9	69		
High	19	83	4	31	8	100
No Response						
FILM ATTENDANCE						
Low						
Medium			6	46		
High			3	23	7	88
No Response	23	100	4	31	1	12

SCHOOL MATHEMATICS STUDY GROUP

SMSG FILM - FILM TEXT EVALUATION STUDY

MATHEMATICS INVENTORY

FORM A

This is a test on some of the ideas in the textbook "Brief Course in Mathematics for Elementary School Teachers." This textbook presents a number of basic concepts which have not, in the past, been stressed in the elementary school program. Consequently, some of the ideas in this test will be unfamiliar to many teachers.

The purpose of this test is to obtain base-line data so that an evaluation of the textbook can be made. A similar test will be given at the end of the course.

Be sure to fill in your code number on the answer sheet.

INSTRUCTIONS

All of the questions in this test are multiple choice. You are to select the correct answer from the five choices given and draw an X through the corresponding letter on your answer sheet. Here are two sample questions.

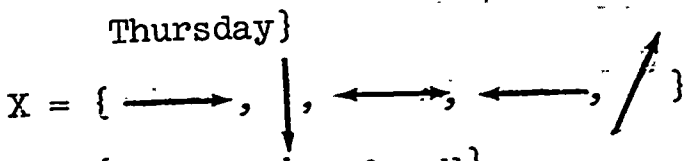
O. The product .046 × .3 equals

A. 0.00138
B. 0.0138
C. 0.138
D. 1.38
E. 13.8

The correct answer is 0.0138, which is opposite the letter B. Therefore an X has been drawn through the letter B on your answer sheet for sample question O.

OO. Which of the following sets can be matched?

W = {Sunday, Monday, Tuesday, Wednesday, Thursday}

X = {  }

Y = {a, e, i, o, u}

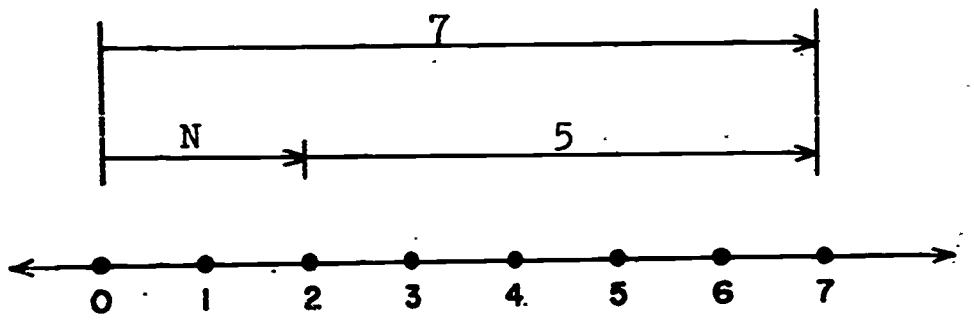
Z = the set of one digit counting numbers less than 6.

A. Only W and X
B. Only X and Y
C. Only X and Z
D. Only W, X, and Y
E. All of these.

Since each of the sets W, X, Y, and Z have five members, they all can be matched. Thus, the correct answer is "All of these", which is opposite letter E. Therefore, draw an X through the letter E on your answer sheet for sample question OO.

There is space for scratchwork on the right hand side of each page of the test. Please do not make extra marks on your answer sheet. Wait for the signal to begin.

1. Which of the following number sentences are equivalent to the sentence whose model is shown on this number line?



(a) $N = 7 + 5$
(b) $N = 7 - 5$
(c) $N + 5 = 7$
(d) $7 - N = 5$

A. Only (a) and (b)
B. Only (b)
C. Only (b) and (c)
D. Only (b), (c) and (d)
E. All of these.

2. If $^{-}8 + {}^{+}4$ is written in each blank below, which of the sentences will be true?

(a) _____ $> {}^{-}8 + {}^{-}8$
(b) _____ $< 0 + {}^{+}5$
(c) _____ $> {}^{+}6 + {}^{+}2$
(d) _____ $> {}^{+}6 + {}^{-}2$

A. Only (a) and (c)
B. Only (b) and (d)
C. Only (a) and (b)
D. Only (c) and (d)
E. None of these

3. Which of the followirg are true?

(a) $\frac{3}{7} \times \frac{2}{5} = \frac{5}{35}$

(b) $\frac{18}{35}$ is the reciprocal of $\frac{35}{18}$

(c) $\frac{4}{5} \times \frac{7}{5} = \frac{11}{5}$

(d) $\frac{0}{7} \times \frac{5}{7} = \frac{5}{49}$

A. Only (a)
B. Only (b)
C. Only (a) and (b)
D. Only (c) and (d)
E. All of these.

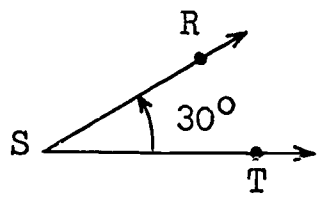
4. In what base are the numerals written if $2 \times 2 = 10$?

A. Base four
B. Base three
C. Base two
D. Base five
E. None of the above is correct.

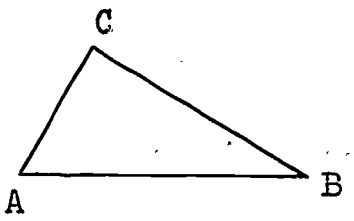
5. Suppose A has a members, and B has b members. If B is a subset of A, then A ~ B

A. has a + b members.
B. has a - b members.
C. has b - a members.
D. has a · b members.
E. is not a set.

6. Given $\angle RST$ as the <u>unit</u> angle



and the $\triangle ABC$



The sum of the measures of the angles of $\triangle ABC$ in terms of the unit angle is:

A. 6 units
B. 7 units
C. 5 units
D. 180 units
E. None of these.

7. A ball club won 4 of the 8 games already played. If it wins the next two games, what percent of the games will it then have won?

A. 80
B. 70
C. 75
D. 50
E. 60

8. The Division Algorithm states: If (a,b) is any ordered pair of whole numbers, it is always possible to find whole numbers q and r with $r < b$ such that $a = (q \times b) + r$. For the ordered pair $(978,37)$, which of the following pairs are correct for q and r?

A. $q = 20,\ r = 238$
B. $q = 6,\ r = 16$
C. $q = 30,\ r = 68$
D. $q = 26,\ r = 16$
E. None of these.

Questions 9 and 10 refer to the addition exercise below:

$$
\begin{array}{rl}
 & 672 = 6 \text{ hundreds} + 7 \text{ tens} + 2 \text{ ones} \\
+ & \underline{834 = 8 \text{ hundreds} + P \text{ tens} + 4 \text{ ones}} \\
 & Q \text{ hundreds} + 10 \text{ tens} + 6 \text{ ones} \\
 & = R \text{ thousands} + S \text{ hundreds} + T \text{ tens} + U \text{ ones} \\
 & = R, S\ T\ U \quad \text{(Final answer)}
\end{array}
$$

9. P =

A. 8
B. 3
C. 83
D. 34
E. 834

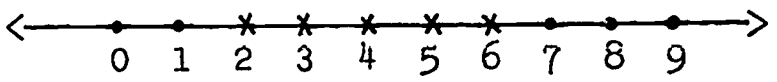
10. In the final answer, R, S T U represents:

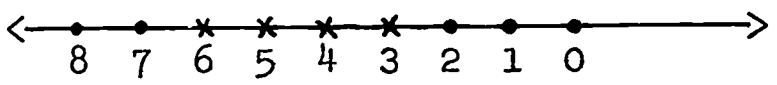
A. The product of the numbers R,S, T and U.
B. The sum of the numbers R, S, T and U.
C. $(R \times 1000) + (S \times 100) + (T \times 10) + (U \times 1)$.
D. $(R \times 1) + (S \times 10) + (T \times 100) + (U \times 1000)$.
E. Eleven thousand, five hundred six.

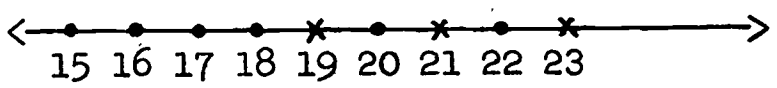
11. In order to find the product 6×9 we might:

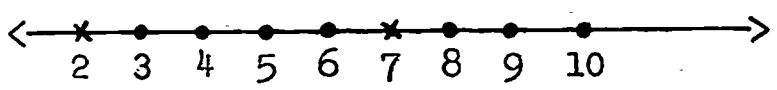
A. Form the union of two disjoint sets with six and nine members.
B. Form a six by nine array.
C. Use the division algorithm.
D. Notice that $(6 \times 9)_{\text{base 10}} = 3_{\text{ten}} \times (6_{\text{three}} \times 9_{\text{three}})$.
E. Draw a triangle with sides 6" and 9" long.

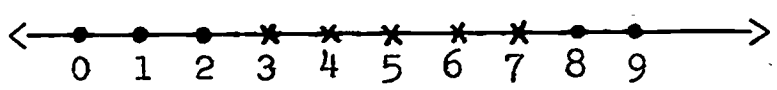
12. Which of the following sets of points best represent the inequality $2 < n < 7$ where n is a <u>whole</u> number?

A. 

B. 

C. 

D. 

E. 

13. Which of the following sets is <u>not</u> closed under multiplication?

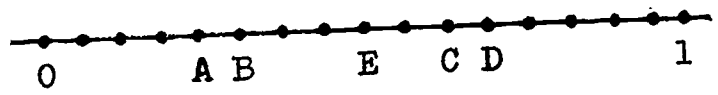
A. the set of integers
B. the set of odd integers
C. the set of negative integers
D. the set of positive rational numbers
E. the set of all rational numbers

14. How many of the following numbers are odd?

3_{five}, 4_{ten}, 36_{seven}, 11_{nine}, 12_{three}

A. none
B. one
C. two
D. three
E. all five

15. Which of the points A, B, C, D, or E on this number line can be named by the fraction $\frac{5}{8}$?



16. 6120_{nine} is how many times as large as 612_{nine} ?

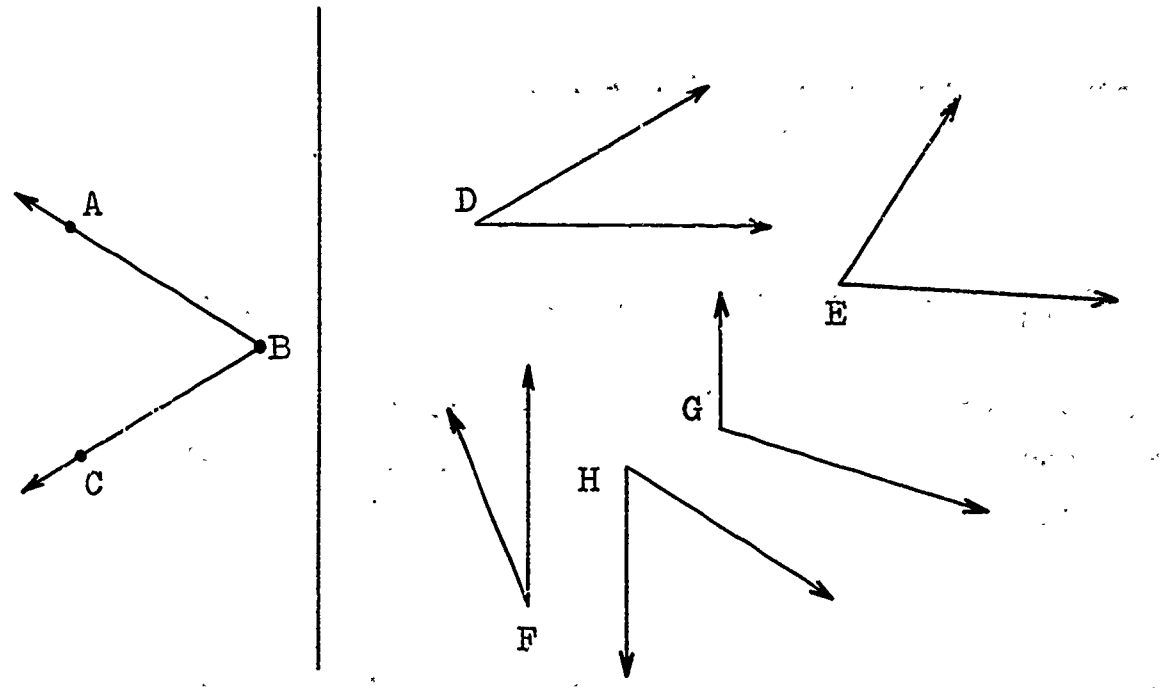
A. twelve
B. ten
C. nine
D. five
E. None of the above is correct.

17. Indicate which English sentence or sentences correspond to the open sentence, $K < 13$.

(a) The temperature is below thirteen degrees.
(b) Joan bought more than thirteen pairs of shoes.
(c) There are fewer than 13 books overdue.
(d) Bill has thirteen dollars.

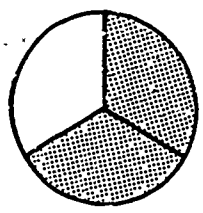
A. Only (a) and (c)
B. Only (c) and (d)
C. Only (a), (b), and (c)
D. Only (b), (c) and (d)
E. All of them.

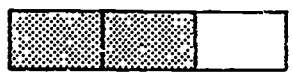
18. Which of the following angles appear to be congruent to ∠ABC ?

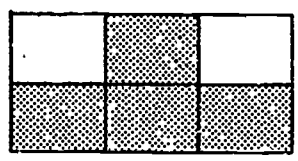


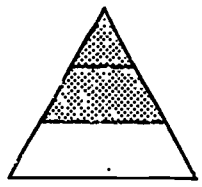
A. Only ∠D and ∠F
B. Only ∠E and ∠H
C. Only ∠D and ∠G
D. Only ∠D, ∠E, and ∠G
E. None of these.

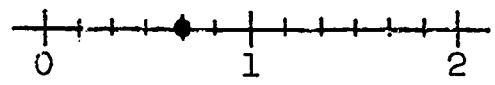
19. Which of the following are models for the same rational number as this one?



(a) 

(b) 

(c) 

(d) 

A. Only (a)
B. Only (c)
C. Only (a) and (b)
D. Only (a), (b) and (d)
E. All of these

20. Which of the following are true?

(a) If $\frac{1}{3} - r = \frac{3}{4}$, $r = \frac{5}{12}$

(b) $(\frac{8}{2} - \frac{3}{2}) - \frac{1}{2} = \frac{8}{2} - (\frac{3}{2} - \frac{1}{2})$

(c) $\frac{3}{4} - \frac{1}{3} = \frac{1}{3} - \frac{3}{4}$

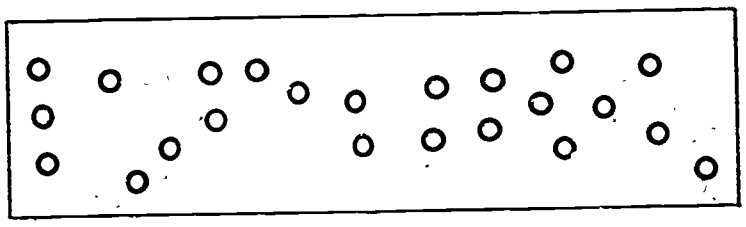
(d) $\frac{4}{5} - \frac{0}{5} = \frac{0}{5}$

A. Only (a)
B. Only (b)
C. Only (a) and (c)
D. Only (b) and (d)
E. None of these.

21. The least common multiple of 18, 27, and 45 is:

A. 3×3
B. $2 \times 3 \times 5$
C. $2 \times 3 \times 3 \times 3 \times 5$
D. $2 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 5$
E. None of the above.

22.



In this question four different numerations of the above set are given. Select the answer that indicates all the correct numerations.

(a) 32_{seven}

(b) 20_{four}

(c) 43_{five}

(d) 24_{nine}

A. Only (a) and (c) are correct.
B. Only (b) and (d) are correct.
C. Only (a), (b) and (c) are correct.
D. Only (b), (c), and (d) are correct.
E. All of the answers are correct.

23. Four of the following numerals are names for the same number. Which one names a different number?

A. 0.025
B. 2.5%
C. $\frac{1}{40}$
D. $\frac{25}{100}$
E. 25 thousandths

24. What is the hundreds digit in the answer to 3375.49 - 861.1?

A. 5
B. 2
C. 4
D. 1
E. 9

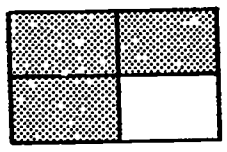
25. What is the number of <u>different</u> prime factors of 60?

A. 0
B. 1
C. 2
D. 3
E. 4

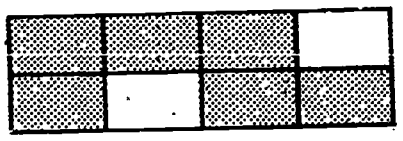
26. Choose the best way to complete this statement: Standard units of measurement are used because

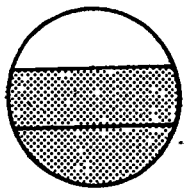
A. it is important for people to use the same unit in dealing with each other.
B. standard units give more accurate measurements than units which are not standard.
C. people have always used them.
D. they are all related to base 10 numeration.
E. the English system is more natural than the metric system.

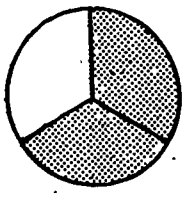
27. Which of the following are models for the same rational number as this one?



(a) 

(b) 

(c) 

(d) 

A. Only (a) and (b)
B. Only (a)
C. Only (d)
D. Only (a), (b) and (c)
E. All of these.

28. The markings on a ruler divide each inch into 8 equal parts. The correct way to report a certain measurement made with this ruler is:

A. $(3\frac{4}{16} \pm \frac{1}{32})$ in.
B. $(3\frac{1}{4} \pm \frac{1}{8})$ in.
C. $(3\frac{1}{4} \pm \frac{1}{16})$ in.
D. $(3\frac{2}{8} \pm \frac{1}{8})$ in.
E. $3\frac{4}{16}$ in.

29. Which of the following are empty sets?

(a) All odd numbers exactly divisible by 2.
(b) Women who have been president of the U.S.A.
(c) All positive even numbers exactly divisible by 5.
(d) All whole numbers which do not have 1 as a factor.

A. Only (b)
B. Only (a) and (b)
C. Only (b) and (c)
D. Only (a), (b) and (d)
E. All of these.

30. Which segment has the least measure?

A. from $^{-}4$ to $^{-}8$ on the number line.
B. from $^{+}6$ to $^{+}9$ on the number line.
C. from $^{-}6$ to 0 on the number line.
D. from 0 to $^{+}5$ on the number line.
E. from $^{-}6$ to $^{+}5$ on the number line.

31. Suppose $\_|\_$ is a binary operation with

$1 \_|\_ 1 = 0$ $\quad$ $7 \_|\_ 2 = 13$

$2 \_|\_ 2 = 3$ $\quad$ $4 \_|\_ 4 = 15$

$5 \_|\_ 6 = 29$ $\quad$ $9 \_|\_ 2 = 17$

What is $6 \_|\_ 3$?

A. 6
B. 3
C. 9
D. 17
E. 18

32. Which of the following are true statements?

(a) $\{A,B\} \cup \{C,D,E\} = \{C,A,B,E,D\}$
(b) $N(\{0,1\}) = 2$
(c) $\{X,Y,Z\} \sim \{X\} = \{Y,Z\}$

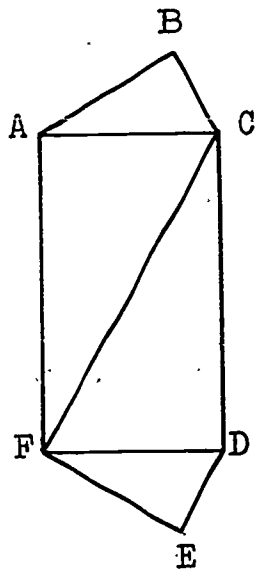
A. None of these
B. Only (a)
C. Only (a) and (c)
D. Only (b) and (c)
E. (a), (b) and (c)

33. The most important common property of the sets $\{A, 2, *\}$ and $\{0, 1, 2\}$ is suggested by

A. 2
B. $\{,,\}$
C. 6
D. empty
E. 3

34. Which of the following statements are true about the figure?

(a) $\triangle ABC \cong \triangle FDE$
(b) $\triangle FDE \cong \triangle ACB$
(c) $\triangle ACF \cong \triangle DFC$
(d) $\triangle ACF \cong \triangle DEF$



A. Only (a) and (c)
B. Only (b) and (d)
C. Only (a) and (b)
D. Only (c) and (d)
E. Only (b) and (c).

35. The inverse operation for addition is:

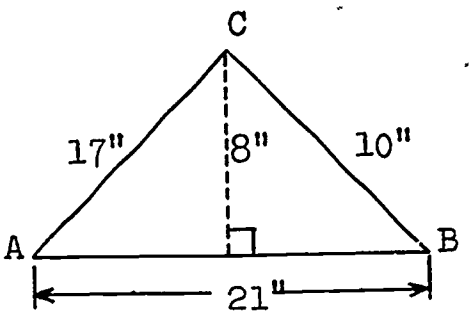
A. addition.
B. subtraction.
C. multiplication.
D. division
E. None of these.

36. What is the sum of 6_{eight} and 3_{eight} ?

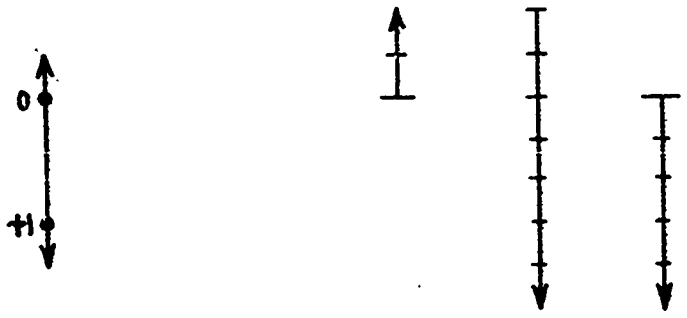
A. 9_{eight}
B. 18_{eight}
C. 10_{eight}
D. 11_{eight}
E. None of these.

37. The area of the triangle shown at the right may be found by

A. Adding 8 and 21.
B. Multiplying 8 by 21.
C. Multiplying 8 by 21 and dividing the result by 2.
D. Multiplying 17 by 21 and dividing the result by 2.
E. Adding 10, 17 and 21.



38. Which of the following sentences does this illustration represent?



(a) $(+\frac{2}{3}) + (-\frac{7}{3}) = (-\frac{5}{3})$

(b) $(+\frac{5}{3}) - (-\frac{2}{3}) = (+\frac{7}{3})$

(c) $(+\frac{2}{3}) - (-\frac{5}{3}) = (-\frac{7}{3})$

(d) $(-\frac{2}{3}) + (+\frac{7}{3}) = (+\frac{5}{3})$

A. Only (a)
B. Only (d)
C. Only (a) and (d)
D. Only (b) and (d)
E. Only (a) and (c)

39. Which of the following is the best example of something unique?

A. a symbol for the number of fingers you have
B. the second house from a certain corner in a residential district
C. the number of eggs in a dozen
D. a point on a ruler which is one inch from the three-inch mark
E. a rectangle with one side five inches long.

40. If the height of a rectangular prism is doubled, and nothing else is changed, what is the ratio of the volume of the new prism to the volume of the original prism?

A. 2:1
B. 1:2
C. 4:1
D. 8:1
E. 1:8

41. If 13 candy bars are to be given to 3 boys so that each boy receives at least one candy bar, which of the following statements must be true?

A. One boy receives 10 candy bars.
B. Each boy receives at least 2 candy bars.
C. One boy receives at least 5 candy bars.
D. One boy receives at least 7 candy bars.
E. The boys all receive a different number of candy bars.

42. If $X = \{b, a\}$ and $Y = \{7,8\}$, the most important property of the set $X \cup Y$ is suggested by

A. $\{\ \}$
B. 7
C. 4
D. the order b, a, 7, 8
E. 2

43. If x, y, z are numerals in base five notation, which of the following are correct?

(a) $x + y = y + x$
(b) $x(y + z) = x \cdot y + x \cdot z$
(c) if $x < y$ and $y < z$ then $x < z$:

A. Only (a)
B. Only (b)
C. Only (a) and (b)
D. Only (a) and (c)
F (a), (b), and (c)

44. Which of the following are true?

(a) $\frac{2}{3} = \frac{4}{6} = \frac{8}{12} = \frac{10}{15} = \frac{14}{21}$

(b) $\frac{2}{3} + \frac{1}{4} = \frac{11}{12}$

(c) $\frac{5}{24} + \frac{7}{18} = \frac{43}{72}$

(d) $\frac{2}{3} \div \frac{5}{7} = \frac{28}{21}$

A. Only (a)
B. Only (a) and (b)
C. Only (c) and (d)
D. Only (a), (b) and (c)
E. All of them.

45. If A and B are two sets which can be matched (put in 1 to 1 correspondence) then:

A. A and B must both be sets of numbers.
B. A and B must have the same number of elements.
C. Neither A nor B can be the empty set.
D. A and B must both be sets of points.
E. A and B must each have one member.

46. If three lines are drawn on the same plane and no two of these lines are parallel, the figure formed could include

A. exactly three angles.
B. exactly two points of intersection.
C. a triangle.
D. two closed curves.
E. a rectangle.

47. Which one of the following division examples will result in the quotient 25.2 ?

A. $5\overline{)\ .126}$
B. $.5\overline{)\ .126}$
C. $.05\overline{)\ .126}$
D. $.005\overline{)\ .126}$
E. $.0005\overline{)\ .126}$

48. How many different planes may contain a certain set of three points if the three points are <u>not</u> in a straight line?

A. 0
B. one
C. two
D. three
E. infinite number

49. Which of the following intersection sets is <u>impossible</u> for a straight line and a triangle?

A. The empty set
B. A set of exactly one point
C. A set of exactly two points
D. A set of exactly three points
E. A set of an infinite number of points.

50. Which of the following are true?

(a) $\frac{5}{3} \div \frac{1}{2} = \frac{1}{2} \div \frac{5}{3}$

(b) $\frac{3}{2} \div (\frac{9}{4} \div \frac{7}{6}) = (\frac{3}{2} \div \frac{9}{4}) \div \frac{7}{6}$

(c) $\frac{5}{3} \div \frac{3}{4} = \frac{5 \times 4}{3 \times 3}$

(d) If $r = \frac{2}{3} \div \frac{1}{4}$, then $r = \frac{8}{3}$

A. Only (c)
B. Only (d)
C. Only (a) and (c)
D. Only (c) and (d)
E. All of these.

SCHOOL MATHEMATICS STUDY GROUP

SMSG FIIM - FIIM TEXT EVALUATION STUDY

MATHEMATICS INVENTORY

FORM B

This is a test on some of the ideas in the textbook "Brief Course in Mathematics for Elementary School Teachers." This textbook presents a number of basic concepts which have not, in the past, been stressed in the elementary school program. Consequently, some of the ideas in this test will be unfamiliar to many teachers.

The purpose of this test is to obtain base-line data so that an evaluation of the textbook can be made.

Be sure to fill in your code number on the answer sheet.

INSTRUCTIONS

All of the questions in this test are multiple choice. You are to select the correct answer from the five choices given and draw an × through the corresponding letter on your answer sheet. Here are two sample questions.

O. The product $.046 \times .3$ equals

A. 0.00138
B. 0.0138
C. 0.138
D. 1.38
E. 13.8

The correct answer is 0.0138, which is opposite the letter B. Therefore an × has been drawn through the letter B on your answer sheet for sample question O.

OO. Which of the following sets can be matched?

W = {Sunday, Monday, Tuesday, Wednesday, Thursday}
X = {→; ↑, ←, ↔, ↙ }
Y = {a, e, i, o, u}
Z = the set of one digit counting numbers less than 6.

A. Only W and X
B. Only X and Y
C. Only X and Z
D. Only W, X and Y
E. All of these

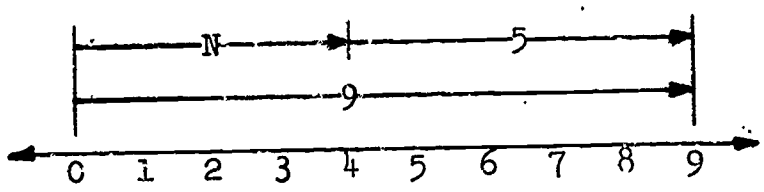
Since each of the sets W, X, Y and Z has five members, they all can be matched. Thus, the correct answer is "all of these," which is opposite letter E. Therefore, draw an × through the letter E on your answer sheet for sample question OO.

There is space for scratchwork on the right hand side of each page of the test. Please do not make extra marks on your answer sheet. Wait for the signal to begin.

1. The product of 875×284 would be how many more than the product of 815×284?

A. 60 tens × 28
B. 60 tens × 284
C. 600 tens × 284
D. 6 tens × 284
E. 1 ten × 284

2. Which number sentence is represented on the number line below?



A. N = 9 + 5
B. N = 9 - 5
C. N + 5 = 9
D. N - 5 = 9
E. 9 - N = 5

3. If 3 boys have a total of 13 marbles and each boy has at least on marble, which of the following statements must be true?

A. Each boy has at least 2 marbles.
B. No boy has more than 7 marbles.
C. One boy has at least 5 marbles.
D. Two boys have the same number of marbles.
E. The boys all have different numbers of marbles.

4. Which of the following sets is closed under subtraction?

A. the set of whole numbers
B. the set of even whole numbers
C. the set of even integers
D. the set of odd integers
E. the set of positive rational numbers

5. Which of the following are true?

(a) $\frac{1}{4} = \frac{2}{8} = \frac{5}{20} = \frac{6}{24} = \frac{8}{32}$

(b) $\frac{2}{3} + \frac{7}{5} = \frac{31}{15}$

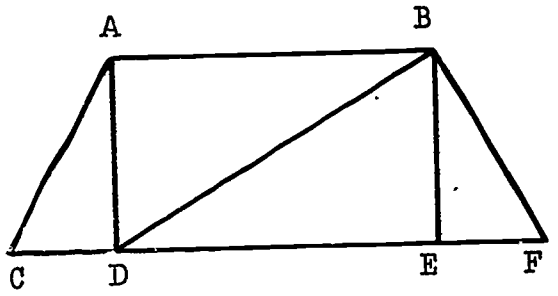
(c) $\frac{4}{21} + \frac{2}{15} = \frac{33}{105}$

(d) $\frac{3}{18} + \frac{7}{30} = \frac{43}{120}$

A. Only (a)
B. Only (a) and (b)
C. Only (c) and (d)
D. Only (a), (b) and (d)
E. All of these

6. Which of the following statements are true about the figure?

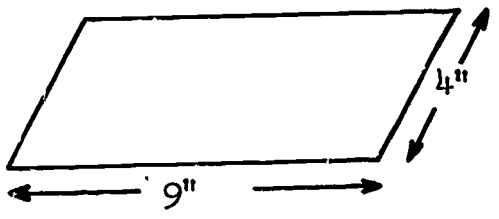
(a) $\triangle ACD \cong \triangle BEF$
(b) $\triangle ABD \cong \triangle EDB$
(c) $\triangle BED \cong \triangle FEB$
(d) $\triangle CAD \cong \triangle FBE$



ABCF is an isosceles trapezoid with altitudes AD and BE.

A. All of these
B. Only (a), (b) and (d)
C. Only (b)
D. Only (c)
E. Only (b) and (d)

7. The area of the parallelogram shown at the right may be found by



A. adding 9 and 4.
B. multiplying 9 and 4.
C. multiplying 9 and 4 and dividing the product by two.
D. multiplying (9 + 4) by $\frac{1}{2}$.
E. none of the above answers is correct.

8. Which of the following are true?

(a) $\frac{3}{5} \div \frac{4}{7} = \frac{4}{7} \div \frac{3}{5}$

(b) $\frac{9}{4} \div (\frac{3}{2} \div \frac{7}{6}) = (\frac{9}{4} \div \frac{3}{2}) \div \frac{7}{6}$

(c) $\frac{8}{7} \div \frac{2}{5} = \frac{8 \times 5}{7 \times 2}$

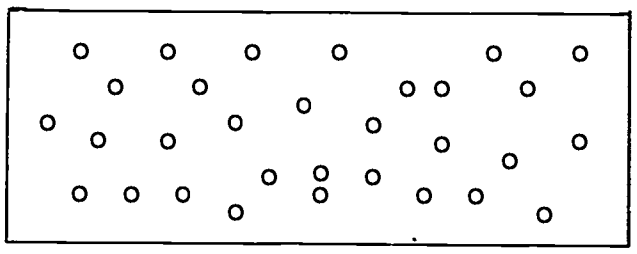
(d) If $r = \frac{2}{5} \div \frac{3}{4}$, then $r = \frac{8}{15}$

A. Only (c)
B. Only (d)
C. Only (a) and (b)
D. Only (c) and (d)
E. None of these.

9. If $A = \{1,2\}$, $B = \{1,2,3\}$ and $A \cup C = B$, how many members does C have?

A. 5
B. 3
C. {3}
D. 1
E. Cannot be determined.

10.



In this question four different numerations of the above set are given. Select the answer that indicates all the correct numerations.

(a) 42_{seven}

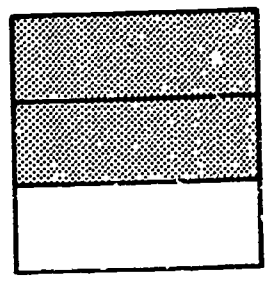
(b) 133_{four}

(c) 111_{five}

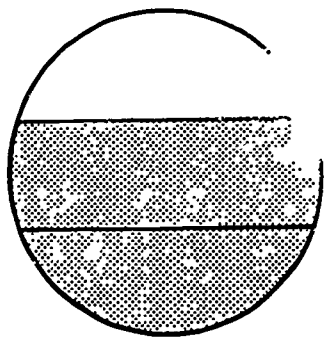
(d) 34_{nine}

A. Only (a) and (c) are correct.
B. Only (b) and (d) are correct.
C. Only (a), (b) and (c) are correct.
D. Only (b), (c) and (d) are correct.
E. All of the answers are correct.

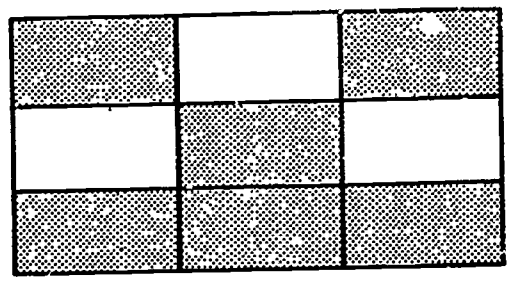
11. Which of the following is a model of the same rational number as the one at the right?



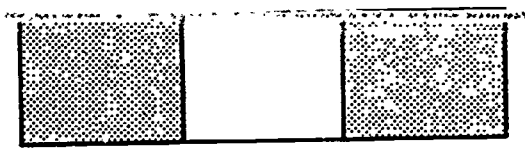
(a)



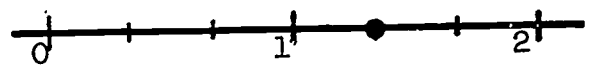
(b)



(c)



(d)



A. Only (a)
B. Only (c)
C. Only (b) and (c)
D. Only (b), (c) and (d)
E. All of these

12. It is correct to write the symbol = between R and S whenever

A. all members of set R are members of set S.
B. R and S are sets with the same number of elements.
C. R and S are numbers.
D. R and S are different names for the same set.
E. R and S are both sets of whole numbers.

13. A polygon must have

(a) exactly one side.

(b) exactly two sides.

(c) at least three sides.

(d) more than three sides.

A. (a) and (b) are correct

B. (b) and (c) are correct

C. (c) is correct

D. (d) is correct

E. None of the answers given above is correct.

14. The common property of all sets which match {2, 4, 6} is:

A. the property of having numbers for elements.

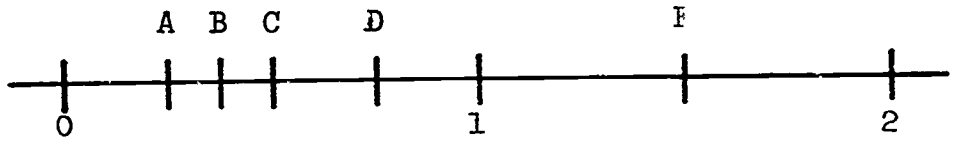
B. the number three.

C. the property of being an even number.

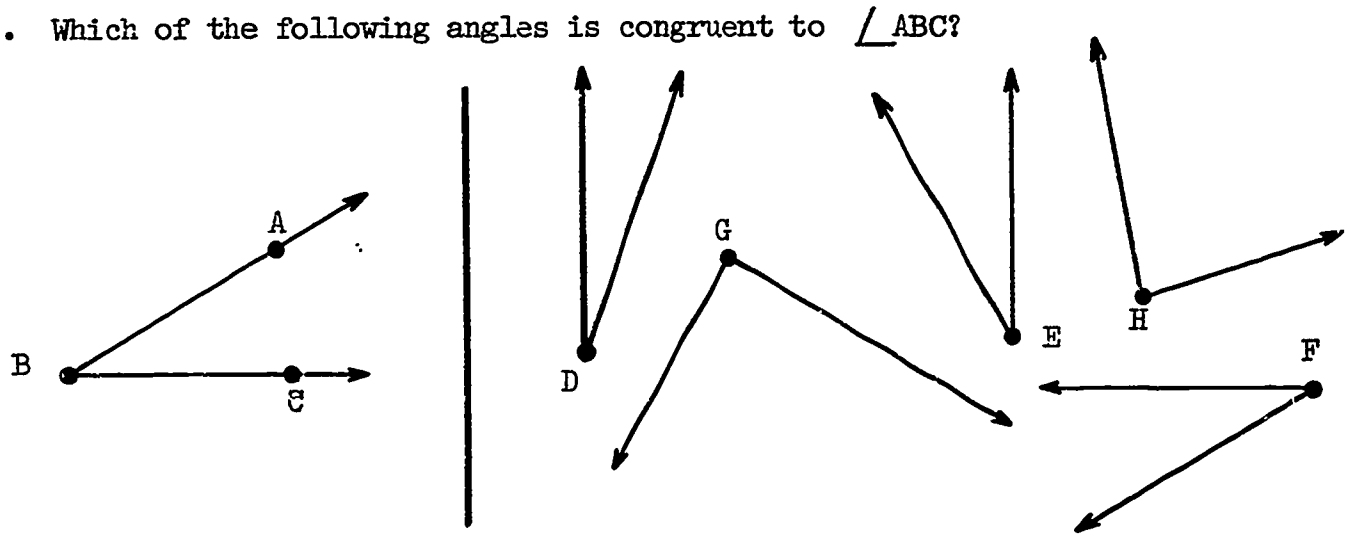
D. the numeral III or the numeral 3, or both.

E. nothing, because there is no common property.

15. Which of the points A, B, C, D or E can be named by the rational number $\frac{3}{8}$?



16. Which of the following angles is congruent to $\angle ABC$?



A. $\angle D$ and $\angle E$

B. $\angle E$ and $\angle F$

C. $\angle G$ and $\angle H$

D. $\angle D$, $\angle E$ and $\angle F$

E. All of these

17. Which one of the following intersection sets is impossible for a straight line and a square?

A. The empty set.
B. A set of 1 point.
C. A set of 2 points.
D. A set of 3 points.
E. A set of an infinite number of points.

18. 12_{five} is the base five numeral for 7_{ten}. Which of the following statements is correct?

A. 12_{five} is divisible by 2_{five}.
B. 12_{five} is a prime number.
C. 12_{five} is divisible by 6_{ten}.
D. 12_{five} is divisible by 2_{five}, 3_{five} and 4_{five}.
E. $12_{five} = 12_{ten}$.

19. Which of the following is a property of division? (a, b, and c represent non-zero numbers.)

A. $(a \div b) \div c = a \div (b \div c)$
B. $(a + b) \div c = (a \div c) + (b \div c)$
C. $a \div b = b \div a$
D. $a \div (b + c) = (a \div b) + (a \div c)$
E. $a \div 1 = 1$

20. If $^{-}7 + ^{+}2$ is written in each blank below, which of the sentences will be true?

(a) _____ $< ^{-}4 + ^{-}2$
(b) _____ $< 0 + ^{-}6$
(c) _____ $> ^{+}4 + ^{-}11$
(d) _____ $> ^{-}7 + ^{-}9$

A. Only (a) and (c)
B. Only (b) and (d)
C. Only (a) and (b)
D. Only (c) and (d)
E. None of these

21. Suppose $\setminus$ is a binary operation with

$3 \setminus 4 = 8$ $\quad$ $2 \setminus 6 = 9$ $\quad$ $1 \setminus 1 = 3$

$5 \setminus 6 = 12$ $\quad$ $3 \setminus 7 = 11$ $\quad$ $5 \setminus 4 = 10$

What is $5 \setminus 9$?

A. 18
B. 15
C. 4
D. 41
E. 6

22. What is the product of 4_{five} and 2_{five}?

A. 13_{five}
B. 11_{five}
C. 6_{five}
D. 7_{five}
E. 8_{five}

23. Which of the following are true?

(a) $\frac{5}{3} \times \frac{2}{7} = \frac{10}{21}$

(b) $\frac{3}{50}$ is the reciprocal of $\frac{50}{3}$

(c) $\frac{5}{3} \times \frac{7}{3} = \frac{35}{3}$

(d) $\frac{3}{7} \times \frac{0}{10} = \frac{3}{70}$

A. Only (a)
B. Only (b)
C. Only (a) and (b)
D. Only (a) and (d)
E. All of these

24. Which of the following are empty sets?

(a) The set of all primes exactly divisible by 2.

(b) The set of all bald headed men.

(c) The set of all positive even numbers exactly divisible by 11.

(d) The set of all fractions with 0 as the numerator.

A. Only (a)
B. Only (b) and (c)
C. Only (a) and (c)
D. Only (a), (c) and (d)
E. None of these.

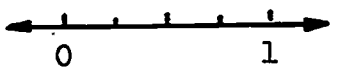
25. If 11% of a number equals $660, the number is

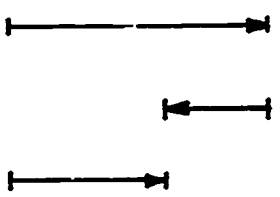
A. 89% of $660.
B. less than $660.
C. equal to $660.
D. 111% of $660.
E. not listed among these answers.

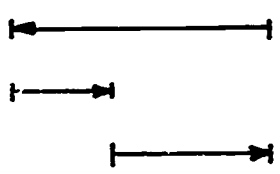
26. The operation which is the inverse of multiplication is

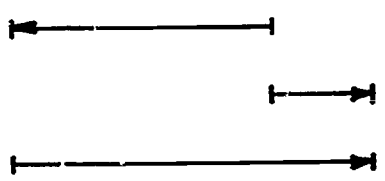
A. addition.
B. subtraction.
C. multiplication.
D. division.
E. none of these.

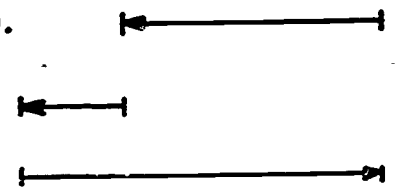
27. Which model represents

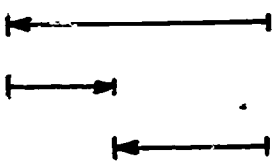
$\left(\frac{-5}{4}\right) + \left(\frac{2}{4}\right)$ using the scale 

A. 

B. 

C. 

D. 

E. 

28. Which measure is the least?

A. From $^{-}4$ to $^{-}8$ on the number line.
B. From $^{+}6$ to $^{+}9$ on the number line.
C. From -6 to 0 on the number line.
D. From 0 to +5 on the number line.
E. From $^{-}6$ to $^{+}5$ on the number line.

29. The dimensions of a rectangle were reported as $2\frac{1}{4} \pm \frac{1}{4}$ and $1\frac{7}{8} \pm \frac{1}{8}$ inches. What is the largest area in square inches which the rectangle could have?

A. $4\frac{1}{2}$
B. $4\frac{19}{32}$
C. $4\frac{11}{16}$
D. 5
E. $5\frac{5}{16}$

Questions 30 and 31 refer to the addition exercise below:

546 = 5 hundreds + 4 tens + 6 ones
+729 = 7 hundreds + P tens + ^ ones
Q hundreds + 6 tens +15 ones
= R thousands + S hundreds + T tens + U ones
= R,STU (final answer)

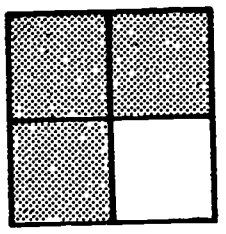
30. Q =

A. 5
B. 7
C. 12
D. 13
E. 35

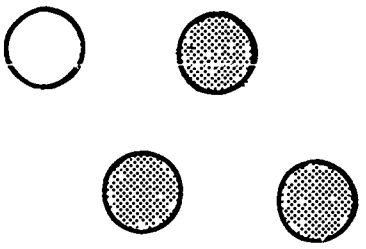
31. In the final answer, R,STU represents:

A. the sum of the digits R, S, T and U.
B. the product of the numbers R, S, T and U.
C. R × 1 + S × 10 + T × 100 + U × 1000.
D. R × 1000 + S × 100 + T × 10 + U × 1.
E. Twelve thousand, seven hundred, fifty.

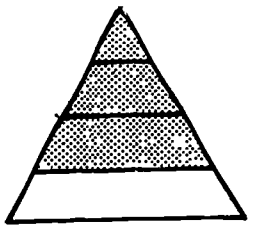
32. Which of the following models is for the same rational number as the model on the right?



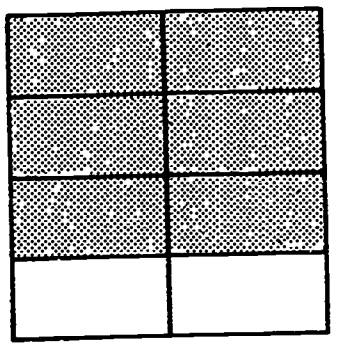
(a)



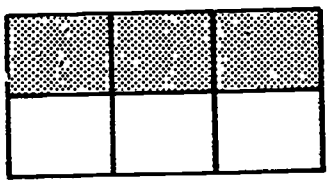
(b)



(c)



(d)



A. Only (d)
B. Only (a)
C. Only (a) and (c)
D. Only (a), (b) and (c)
E. All of these

33. Which of the following are true?

(a) If $\frac{1}{4} - p = \frac{3}{32}$, $p = \frac{5}{32}$

(b) $(\frac{4}{3} - \frac{2}{3}) - \frac{1}{3} = \frac{4}{3} - (\frac{2}{3} - \frac{1}{3})$

(c) $\frac{5}{6} - \frac{2}{3} = \frac{2}{3} - \frac{5}{6}$

(d) $\frac{9}{4} - \frac{8}{0} = \frac{1}{4}$

A. Only (a)
B. Only (b)
C. Only (a) and (c)
D. Only (b) and (d)
E. None of these

34. The quotient 1.44 is the answer to the division problem

A. $3.6\overline{)\,518.4}$

B. $3.6\overline{)\,.5184}$

C. $.36\overline{)\,51.84}$

D. $.36\overline{)\,.5184}$

E. $36\overline{)\,518.4}$

35. How many different prime factors does the number 72 have?

A. 0

B. 1

C. 2

D. 3

E. 5

36. In order to find the product 5×11 we might:

A. use the division algorithm.

B. form the union of two disjoint sets with five and eleven numbers.

C. prove that 5 base eleven = 11 base five.

D. form a five by eleven array.

E. draw a triangle with sides 5" and 11" long.

37. If A and B are two sets which have the same number of elements, then:

A. A and B must both be sets of numbers.

B. neither A nor B can be the empty set.

C. A and B must be sets of points.

D. A and B can be put in 1 to 1 correspondence.

E. A and B are different names for the same set.

38. Four of the following five numerals are names for the same number. Which one is a name for a different number?

A. 0.0125

B. $1\frac{1}{4}\%$

C. $\frac{1}{80}$

D. $\frac{125}{10000}$

E. 125 thousandths

39. Choose the best way to complete this statement:

Standard units of measurement are used

A. because throughout history people have used them.

B. because they are all related to base 10 numeration.

C. so that people can communicate with each other.

D. because they give more accurate measurements than non-standard units.

E. because scientific research requires metric units.

40. The least common multiple of 8, 12, and 20 is

A. 2×2.

B. $2 \times 3 \times 5$.

C. $2 \times 2 \times 2 \times 3 \times 5$.

D. $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 5$.

E. none of the above.

41. Which of the following is true?

(a) $\{\Sigma, 0, \square\} \sim \{\triangle, \diamond\} = \{\triangle, \diamond, \Sigma, 0, \square\}$

(b) $N(\{2, 4, 6, 8\}) = \{4\}$

(c) $\{X, Y, Z\} \cup \{X, Z\} = \{Y\}$

A. Only (a)

B. Only (b)

C. Only (c)

D. Only (a) and (c)

E. none of these

42. In which base does the numeral 53 represent an even number?

A. twelve

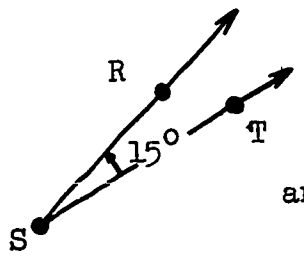
B. ten

C. eight

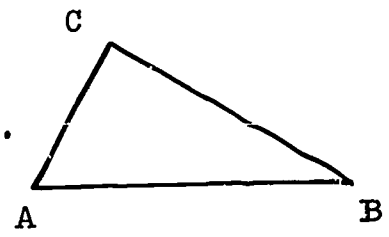
D. seven

E. six

43. Given $\angle RST$ as a unit angle,



and the $\triangle ABC$.



The sum of the measures of the angles of the triangle in terms of the unit angle is

A. 10 units.
B. 12 units.
C. 14 units.
D. 180 units.
E. 360 units.

44. What is the hundreds digit in the answer to 7452.1 - 180.61?

A. 1
B. 9
C. 3
D. 2
E. 6

45. The lengths of the sides of a triangle are 6, 8 and 9 inches. Which of the following are the lengths of the sides of a triangle similar to it?

A. 3, 4, 6 inches
B. 2, 3, 4 inches
C. 9, 12, 16 inches
D. 18, 24, 27 inches
E. none of the above

46. If the side of a cube is multiplied by three, the volume of the cube is

A. multiplied by three.
B. multiplied by nine.
C. multiplied by twenty-seven.
D. divided by twenty-seven.
E. divided by nine.

47. The Division Algorithm states: If (a,b) is any ordered pair of whole numbers, it is always possible to find whole numbers q and r with $r < b$ such that $a = (q \times b) + r$. What are q and r for the ordered pair (6535 47)?

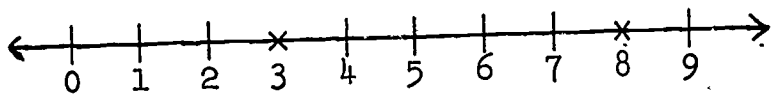
A. q = 100, r = 183
B. q = 139, r = 2
C. q = 100, r = 1
D. q = 130, r = 425
E. none of the answers above is correct.

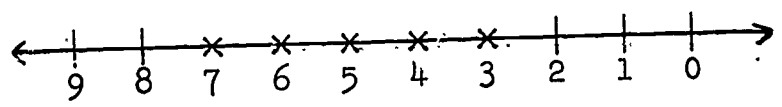
48. Select the answer which indicates the English sentence or sentences which correspond to the open sentence, $y > 10$.

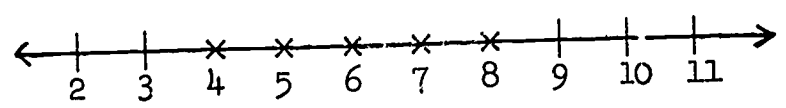
(a) I am more than ten years old.
(b) John has ten dollars.
(c) The board is over ten inches long.
(d) There are ten marbles in the bag.

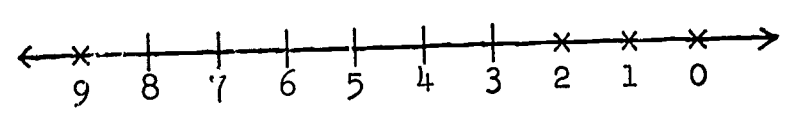
A. Only (a) and (b) are correct.
B. Only (b) and (c) are correct.
C. Only (a) and (c) are correct.
D. Only (c) and (d) are correct.
E. Only (a), (c) and (d) are correct.

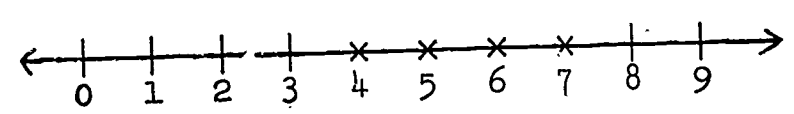
49. Which of the following sets of whole numbers best represents the inequality $3 < n < 8$?

A. 

B. 

C. 

D. 

E. 

50. At a certain moment in a certain class Mary has the same number of pencils as Jane has rulers; Jane has the same number of rulers as Ellen has books; and Ellen has a different number of books than Mary has pencils. We can be sure that

A. pencils, rulers and books cannot be counted with the same numbers.

B. Mary has the same number of rulers as Jane has pencils.

C. the number of pencils Ellen has is different than the number of books Mary has.

D. the number of books Ellen has is smaller than the number of pencils Mary has.

E. there are at least two children in the class with the same first name.